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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/820,695	03/30/2001	Si Yi Li	015290-500	4162

21839 7590 06/28/2006

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EXAMINER

OLSEN, ALLAN W

ART UNIT	PAPER NUMBER
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1763

DATE MAILED: 06/28/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

**Application No.**

09/820,695

**Applicant(s)**

LI ET AL.

**Examiner**

Allan Olsen

**Art Unit**

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 23 May 2006.  
2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.  
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-3,6,7,9,10,12-25,27 and 28 is/are pending in the application.  
4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.  
5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.  
6) ☒ Claim(s) 1-3,6,7,9,10,12-25,27 and 28 is/are rejected.  
7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.  
8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.  
10) ☒ The drawing(s) filed on 01 June 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)  
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)  
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.  
4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.  
5) ☐ Notice of Informal Patent Application (PTO-152)  
6) ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

On May 23, 2006, a request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on May 5, 2006 has been entered.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

**Claim 6 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.**

Claim 6 recites, "...comprising a metal-containing layer selected from the group consisting of doped and undoped polycrystalline or single crystal silicon...". While doped polycrystalline may comprise a metal, the following two members of the Markush group, undoped polycrystalline silicon and single crystal silicon, are not appropriate members of a Markush group that is directed to a "metal containing layer".

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

**Claims 1, 9, 10, 12, 13, 19, 20 and 27 are rejected under 35 U.S.C. 102(e) as being anticipated US Patent 6,607,675 issued to Hsieh et al. (hereinafter, Hsieh).**

Hsieh teaches etching a carbon-doped, low-k dielectric layer on a semiconductor substrate. Hsieh teaches using an etchant consisting of  $C_xF_y$ ,  $NH_3$  and Ar (abstract). Hsieh teaches that  $C_xF_y$  may be  $C_5F_8$  (column 4, line 9). Hsieh teaches an etchant having a C: N atomic ratio of 0.3:1 which, when using  $C_5F_8$  is satisfied with a  $C_5F_8$  flow rate that is 6% of the  $NH_3$  flow rate (column 3, line 65- column 4, line 2). Hsieh teaches achieving an etch selectivity of at least 5 with respect to the overlying mask (column 5, lines 48-52). Hsieh teaches supplying the  $C_xF_y$  and the  $NH_3$  at flow rates within the claimed ranges (column 4, lines 37-39). Hsieh teaches applying bias power to the substrate and maintaining the chamber pressure and substrate temperature within the claimed range (column 4, line, 45 and column 5, ~line 25). Hsieh teaches a dual frequency parallel plate plasma reactor with showerhead electrode and a bottom electrode on which the substrate is supported (column 3, lines 36-45).

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

**Claims 2, 3, 6, 7, 14-17, 21 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hsieh in view of US Patent 6,455,411 issued to Jiang et al. (hereinafter, Jiang).**

The above note teaching of Hsieh is herein relied upon.

Hsieh does not teach etching the low-k dielectric in the context of a dual damascene process wherein a 0.25  $\mu$  opening, with an aspect ratio of 5:1, is etched into a dielectric layer that has an overlying and underlying layer of silicon nitride or carbide, and in which the opening is subsequently filled with metal.

Jiang teaches a process of etching a carbon doped low-k dielectric in the context of a dual damascene process is etched into a dielectric layer that has an overlying and underlying layer of silicon nitride or carbide, and in which the opening is subsequently filled with metal. See figure 2 and column 2, line 48 - column 3, line 15.

It would have been obvious to one skilled in the art to combine Hsieh and Jiang because Hsieh's disclosure pertains to etching a low-k dielectric layer but Hsieh's

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disclosure is generic with respect to the context in which the dielectric layer placed and Jiang teaches etching a similar dielectric layer and that this dielectric has utility in the context of a dual damascene process.

It would have been obvious to one skilled in the art to apply the combined teaching of Hsieh and Jiang to a process of etching of 0.25  $\mu$  features with a 5:1 aspect ratio because Jiang teaches etching a contact hole to a depth of 10,500 and the industry standard for the size of contact holes at the time of Hsieh's and Jiang's disclosures was 0.2 microns or less and this size opening in combination with an etching depth of 10,500 angstroms corresponds to a 5:1 aspect ratio.

**Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hsieh in view of US Patent 6,159,792 issued to Kim et al. (hereinafter, Kim).**

The above noted teaching of Hsieh is herein relied upon.

Hsieh does not teach using  $N_2$  and therefore does not teach an etchant consisting essentially of  $C_5F_8$ ,  $N_2$  and Ar.

Kim teaches etching an oxide with an etchant consisting of  $C_5F_8$ ,  $N_2$  and Ar or  $C_5F_8$ ,  $NH_3$  and Ar (column 3, lines 60-66).

It would have been obvious to one skilled in the art to replace the  $C_5F_8$ /  $NH_3$ / Ar etchant of Hsieh with the  $C_5F_8$ /  $N_2$ / Ar etchant of Kim because Kim teaches that because teaches the functional equivalence of these two etchant mixtures.

**Claims 22, 23, and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 6,753,263 issued to Ito et al. (hereinafter, Ito).**

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Ito teaches etching a carbon doped low-k dielectric below a  $\text{Si}_3\text{N}_4$  (see, for example, figures 4-7). Ito teaches a  $\text{SiO}_2$  to  $\text{Si}_3\text{N}_4$  selectivity of greater than 5 (see Table 1, column 9). Ito teaches an etchant comprising  $\text{C}_4\text{F}_8$  and a lesser amount of  $\text{CH}_2\text{F}_2$  (see figure 8). Ito teaches adding  $\text{N}_2$  to the etchant (column 5, line 60; column 15, line 60).

Ito does not teach that the total  $\text{C}_4\text{F}_8$  and  $\text{CF}_2\text{H}_2$  flow rate is 30% or less than the  $\text{N}_2$  flow rate.

It would have been obvious to one skilled in the art to use a total  $\text{C}_4\text{F}_8$  and  $\text{CF}_2\text{H}_2$  flow rate that is 30% or less than the  $\text{N}_2$  flow rate because Ito discusses the addition of  $\text{N}_2$  within the context of including additives such as Ar and Ito teaches using a very large excess of Ar. Furthermore, it is considered obvious to optimize the process conditions such as flow rates.

**Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ito in view of US Patent 6,184,119 issued to Ku et al (hereinafter, Ku).**

The above noted teaching of is herein relied upon.

Ito does not teach using a dual frequency reactor.

Ku teaches using a dual frequency reactor.

It would have been obvious to one skilled in the art to use the dual frequency reactor of Ku because Ku states; "a dual-frequency driven plasma source ...can achieve high etch selectivity of  $\text{SiO}_2$ -to- $\text{Si}_3\text{N}_4$ " (column 1, lines 34-38).

***Response to Arguments***

Applicant's arguments have been considered but are moot in view of the new grounds of rejection.


***Conclusion***

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allan Olsen whose telephone number is 571-272-1441. The examiner can normally be reached on M, W and F: 1-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on 571-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read "Allan Olsen", is positioned to the left of the printed name and title.

Allan Olsen  
Primary Examiner  
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